management of our national forests. BOERKER[2] has collected and organized a mass of scattered data and presented them in a very readable form. While particularly well suited in its style of presentation to appeal to the general public, it will prove equally welcome to foresters and botanists who wish to know the history of the organization of these forests and the different forms of administration under which they have attained their present dimensions. The addition of a bibliography would have added much to the scientific value of the volume without detracting from its popular interest. It may also be criticized because of the lack of a suitable index to facilitate reference; but on the whole the work is well done, the material has been well organized, is attractively presented, and so far as the reviewer is able to judge the data are entirely accurate and reliable.—GEO. D. FULLER.

Grasses and grasslands of South Africa.—In order to facilitate the study of the extensive grasslands of South Africa, BEWS[3] has prepared a series of keys for the identification of the 500 species of grasses which form so conspicuous a portion of the flora of that part of the continent. These keys seem to be well suited to serve the purpose for which they are intended, but the other parts of the volume are of far more interest to the American reader. In them are discussed: (1) the structural and ecological characteristics of the principal species; (2) general character of the grasslands and the development of the various association types; and (3) economic application of the ecological principles involved. It is interesting to find types comparable to the "short grass," "wire grass," and "prairie grass" of North America, as well as a tall coarse *Andropogon* association, this last developing upon potential woodland areas, and a mountain tussock grassland. The discussion of the successional relations of these and other association types into which grasses enter gives a comprehensive general sketch of the plant communities of the major portion of South Africa.

In the final chapter the feeding value of the different types of grassland, as well as the comparative merits of native and introduced species, is discussed. The effect upon the productivity of various types of grassland by various kinds of grazing and the results from grass burning are considered and some of the ecological problems involved are pointed out. An appendix contains a list of English, Dutch, Zulu, and Sesuto names of the more important species.—GEO. D. FULLER.

NOTES FOR STUDENTS

Vegetation of Cape Breton.—Separated from the mainland of Nova Scotia by a narrow strait, the island of Cape Breton lies between the Gulf of St. Lawrence and the Atlantic in latitude 45–47° N. It possesses a climate

[2] BOERKER, RICHARD, H.D., Our national forests. pp. lxix+238. *figs. 80.* 1918. New York: Macmillan Co.

[3] BEWS, J. W., The grasses and grasslands of South Africa. 8vo. pp. 161. *figs. 24. map.* Pietermaritzburg: Davis & Sons. $2.00 (postpaid from author).

characterized by long winters and short cool summers, the extremes of temperature being modified by the close proximity of the ocean. A rainfall of 50 in. per year and frequency of fogs make the water supply sufficient for a luxuriant vegetation, which has been carefully studied by NICHOLS.[4] He finds two climatic forest formations represented, the deciduous type upon the lowlands which fringe the coast, and the coniferous type upon the granite uplands which occupy the entire interior portion of the island. These are about 1000 ft. above sea level and form a slightly undulating glaciated surface.

The lowlands show many associations depending upon the stage of development attained, and these variations and the successive stages which have led to their development are carefully discussed and the climax shown to be a forest dominated by beech, sugar maple, and hemlock, together with small quantities of *Betula lutea*, *Picea canadensis*, and *Abies balsamea*. The abundant details of these studies cannot be noticed in a brief review, but two problems in the relationship between the deciduous and evergreen elements of the vegetation are decidedly interesting. It has been found that upon the destruction of the deciduous forest by culling or burning it is succeeded by a coniferous stand dominated by *Abies balsama* and *Picea canadensis;* and further that the climax deciduous forest possesses a very considerable percentage of small *Abies balsamea* which never seem to succeed in competition with the other tree members of the association. NICHOLS presents evidence showing that the balsam fir is fairly shade tolerant, and that its lack of success is due to its short life, maturity being attained in about one century, and to its great susceptibility to fungus diseases.

It seems evident that the coniferous forest dominated by *Abies* and *Picea* is the climatic rather than the edaphic climax of all portions of the island exceeding 700 ft. in elevation. The factors which appear to differentiate the climate of the uplands from that of the lowlands are the greater extremes of temperature and the greater humidity due to fogs and low-hung clouds which frequently envelop the more elevated areas.

This upland forest is of decided importance in the production of pulp wood, its contents being estimated at 12,000,000 cords. Upon the more exposed parts of the uplands are developed "the barrens," closely resembling the tundras of the subarctic. The low vegetation of "the barrens" varies from a degenerate coniferous forest of the Krummholz type, where the distorted trees are limited in height to the thickness of the snow cover, to coniferous and ericaceous heaths, and to bogs of varied character. These bogs occupy considerable portions both of the lowlands and "the barrens," their most striking form being the raised peat bogs of the latter region, which have received careful attention, so that many problems connected with their development have been elucidated.

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[4] NICHOLS, GEO. E., The vegetation of northern Cape Breton Island, Nova Scotia. Trans. Conn. Acad. 22:249–267. *figs.* 70. 1918.

NICHOLS finds the bogs of the raised type, corresponding to the "Hochmoors" of Europe, occurring upon this continent in Newfoundland and those parts of eastern Canada and Maine which are in close proximity with the sea coast. The climatic factors necessary for their development are abundant precipitation, relatively low atmospheric humidity, cool summers, and the absence of extremely low temperatures such as prevail farther inland. One of the necessary edaphic factors is an impervious substratum, here furnished by the Laurentian rocks. This is vitally important, since the source of water supply is the rainfall and not springs, as some have assumed.

The early stages of these raised bogs are not essentially different from those obtaining in bogs of the more common and familiar type, but their subsequent development is dependent upon the presence of distinct types of *Sphagnum*. NICHOLS classifies these mosses into 5 ecological groups, beginning with the decidedly aquatic and ending with those of comparatively xerophytic habits. It is upon the growth of the mesophytic and xerophytic sphagnums that the development of the dry raised bog depends. These mosses are cushion-forming in habit, and their successive development elevates the central portions of the bog many feet above its rim. Such a raised bog presents a hummocky surface, and except in wet weather a rather firm springy substratum quite dry underfoot. Upon the surface in addition to the xerophytic *Sphagnum* are other mosses such as *Racomitrium* and *Polytrichum*, some fruticose lichens, and several ericaceous shrubs for the most part less than a foot high. Scattered and dwarfed specimens of *Larix* and *Picea mariana* also occur. A typical specimen of the former, scarcely a foot high, possessed a trunk 1 inch in diameter showing more than 50 annual rings.

Another striking feature of the region seems to be the development of subsequent ponds within the bog area. These differ decidedly from the marginal trenches described by STALLARD,[5] which are due to fire consuming the peat in the shallow marginal portions of the bog during periods of unusual drought. The ponds in the Cape Breton bogs are due to the impervious nature of the peat from some of the sphagnums forming barriers and dams which obstruct the drainage on gentle slopes. Such ponds function as storage reservoirs, retaining much of the water which accumulates in them during wet periods and thus insuring to adjacent areas a constant supply throughout the season.

The development of the raised bogs, the subsequent bog ponds, and other features of the vegetation are illustrated by diagrams and photographs. The various successions are carefully traced and clearly described, the various communities being classified according to the system already noted.[6] In its comprehensive character, its abundance of detail, and its notable contributions to various phases of ecology, including the relationships between deciduous and coniferous forests, the ecology of the sphagnums and of the development of

[5] STALLARD, HARVY, The origin of *Sphagnum* atolls. New Phytol. **15**:250–256. 1918.

[6] BOT. GAZ. **66**:385–388. 1918.

raised bogs, this report stands as one of the most notable of recent years.—GEO. D. FULLER.

A new fixative for paraffin sections.—Dr. KOLOMAN SZOMBATHY[7] describes a new method of fixing paraffin sections to the slide. The fixative is claimed to have the advantage of not being dissolved by alkaline stains, and furthermore in not being stained by hematins and aniline stains such as eosin fuchsin, orange G., etc. The formula given by him is as follows: gelatin 1 gm., distilled water 100 cc., salicylate of soda (a 2 per cent solution) 1 cc., pure glycerine 15 cc.

Dissolve the gelatin in water at 30°, add the salicylate of soda, shake well, cool, and filter. To this add 15 gm. of pure glycerine. The solution obtained should be perfectly clear. A small amount of the fixative together with a drop or two of a 2 per cent formalin solution is placed on the slide, smeared evenly over the surface, and rubbed in well. Care should be observed that the formalin is mixed with the fixative. The sections or paraffin ribbons are then placed on the fixative and permitted to dry in the thermostat or any other warm place which is protected from dust. The formalin "tans" the gelatin and makes it insoluble. A modification of the method consists in exposing the slides, which have been mounted without the use of formalin solution, to vapors of concentrated formalin in a thermostat. The effect of the formalin is identical. A third method consists in preparing a solution of equal parts of 1 per cent gelatin in water and 2 per cent formalin. The fixative is then used as recommended for albumen fixative.

The writer has tested the fixative recommended by SZOMBATHY and finds it to be an excellent one. Material known to be difficult to retain on the slide was tried out. Sections of grass leaves and moss archegonia adhered to the slide even when the latter were left in running water for several days or exposed to a strong solution of hydrogen peroxide. Alkaline stains do not dissolve the gelatin nor do the stains tested stain the background to an appreciable extent.

Of the 3 methods originally recommended, the following modification gives the most satisfactory results. Make up the fixative according to the first formula, put a drop on the slide, and smear it evenly over the surface. Float the paraffin ribbon on the slide on a 2 per cent formalin solution. Warm the slide gently on the usual copper plate and, after the ribbon has straightened and become smooth, drain off the surplus water and let the preparation dry. When one is dealing with material which does not stick to the slide easily, it will be found of advantage to put a small dish of formalin in the thermostat where the preparations are drying, since the formalin vapors help in rendering the gelatin insoluble.

This new fixative is very easily prepared, keeps well, and does hold the sections to the slide. It should come into general use especially for material which does not adhere to the slide under ordinary conditions and when stains

[7] SZOMBATHY, KOLOMAN, Neue Methode zum Aufkleben von Paraffinschmitten. Zeitschr. Wiss. Mikr. 34:334–336. 1918.